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ABSTRACT

Instructional objectives and performance requirements are outlined in this course guide for Welding IV, a competency-based course in advanced arc welding offered at the Community College of Allegheny County to provide students with proficiency in: (1) single vee groove welding using code specifications established by the American Welding Society (AWS) and the American Society of Mechanical Engineers (ASME); (2) controlled penetration welding in the vertical up position; (3) the theory and application of gas metal arc welding; (4) flux-cored arc welding; and (5) gas tungsten arc welding. After introductory material outlining course objectives, required texts, and the materials needed by students in class, the curriculum guide lists evaluation criteria for 15 competency areas: setting up test plates, tacking test plates, electrode manipulation, achieving proper height of finished weld above test plate surface, run off tabs, bend tests, draglines, avoiding gouges on the face of cuts, finishing a cut, fillet welds, ending a weld, and burn through's, undercuts, and surface porosity. The guide then presents an outline of the topics, activities, and tests to be covered and/or completed during each of the 16 weeks in the semester. This outline is followed by objectives and instructions for each of 15 performance tasks to be used in judging student competency. AWS and ASME welder qualifications are appended. (JP)

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ED194133

COMMUNITY COLLEGE OF ALLEGHENY COUNTY

CENTER-NORTH

WELDING IV
72202

3 Credits/2 Lectures/3 Labs

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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JC 800 551

DUTIES & TASKS

COMMUNITY COLLEGE OF ALLEGHENY COUNTY

CENTER-NORTH

WELDING IV
72202

3 Credits / 2 Lectures / 3 Labs

I. DESCRIPTION

This course will offer single vee groove weld-butt joints with backing in the overhead position (4G) using AWS or ASME code specifications.

Controlled penetration (single vee grove weld-open butt joints without backing) will be taught in the vertical up position. The theory and application of gas metal arc welding (GMAW), flux-cored arc welding (FCAW), and gas tungsten arc welding (GTAW) will also be introduced.

Prerequisite: 72201 Welding III or by permission of instructor.

II. OBJECTIVES

A. The student should complete the objectives set up in Welding III before moving to Welding IV objectives.

B. The student should complete the overhead position single vee groove weld-butt joints with backing.

C. The student should become familiar with controlled penetration welding in the vertical up position.

D. The student should have an opportunity to develop a certain amount of welding skill with GMAW, GTAW, and FCAW if he or shee completes the objectives prior to these three processes.

III. TEXTBOOKS

A. Welding Skills and Practices; Giachino, Weeks.
B. Gas Tungsten Arc Welding; Hobart Brothers.
C. Semi-Automatic Arc Welding; Hobart Brothers.

IV. MATERIALS NEEDED BY STUDENTS

A. Welding Helmet (Flip lense)
B. Welding Gloves
C. Safety Glasses
D. Proper Protective Clothing
E. Leather Jacket and Sleeves
F. Pliers

V. SUPPLEMENTARY TEXTS

A. Pocket Welding Guide; Hobart Brothers Company
B. Complete Welding Library. Location: Media Center (Library)
C. Handouts on Welding, Cutting, and Safety supplied by the instructor.

VI. STANDARDS OF ACHIEVEMENT

A. Competencies

Fifteen (15) performance-welding tasks performed by students and graded visually by the welding instructor. (See duties and tasks)

Criterion for evaluation of competencies. (Checked by instructor)

AREA OF EVALUATION	WHAT I AM LOOKING FOR
Vee Grove Weld Butt Joints	
1. Set up test plates	According to applicable code (under welder qualifications)
2. Tacking of test plates	According to instructor's specifications
3. Electrode manipulation	Should conform to instructor's specifications
4. Height of finished weld above test plate surface	1/16 in. to 1/8 in.
5. Run off tabs	Should be welded to height and width of finished weld
6. Undercut on finished weld (surface of test plate)	Little or none
7. Acceptance criteria guided bend tests	Should conform to applicable code specifications (under welder qualifications)
Machine Oxygen Cutting Test Plates	
1. Draglines	Are near vertical; not too pronounced
2. Gouging on face of cut	Due to slag inclusions or lack of penetration
3. Finished cut	Very little if any visable signs of slag inclusions or lack of penetration; a clean cut should be produced the length of the test plate (refer to draglines above)

Gas Tungsten Arc Welding

TEXT: Hobart - 269 - Gas Tungsten Arc Welding

Topic 26: (Visual inspection test aluminum) Page 82-83

Gas Metal Arc Welding

TEXT: Hobart - 269 - Semi-Automatic Arc Welding

Weld Quality Inspection (Visual Method) Page 31

Flux Cored Arc Welding

	AREA OF EVALUATION	WHAT I AM LOOKING FOR
1.	Fillet Welds	Should be equal-leg
2.	Crater (end of weld)	Defects: Not filled to bead height Crater porosity caused by removing welding gun before crater is solidified.
3.	Burn thru	Amperage too high
4.	Undercutting of weld	Travel speed too high for amp & voltage settings. Voltage too high Improper welding gun movement
5.	Surface porosity	Caused by dirt, grease, etc. Shielding gas flow-set too low

B. Written test (1) consisting of:

1. Multiple choice
2. True and false
3. Essay
4. Written tests scheduled throughout the semester including the final exam.

C. Grading (See Standards of Achievement and Grading)

1. Upon satisfactory completion of all performance tests and written examinations, the student is assigned a letter grade (see appendix).

2. If the student does not satisfactorily complete the performance tests and written examinations, a grade of "I" (Incomplete) is assigned and the student should be encouraged to register again for Welding IV the following semester.

NOTICE TO INSTRUCTORS:

These chapters on theory and practical application are to be covered during the course. The format on the Topic Outline is suggested. Changed in the sequence in which it is presented are at the discretion of the instructor to compensate for class size and/or equipment availability.

Explanation of headings under Topic Outline.

WEEK:

The Topic Outline is set up for a 16-week course.

PAT CASSETTE TOPIC:

This is programmed Audio-Visual Training, by Hobart. Projector and cassettes are located in the instructors' cabinet. 16 mm movies are located in the Media Center. You must give five (5) days notice to reserve for showing.

CLASS TOPIC:

Instructor and student objectives.

ELECTRODE SIZE/TYPE:

To be used in relation to the class topic.

PERFORMANCE OBJECTIVES:

These are welding test plates perfomed by the students and graded visually by the instructor. (Pictures of finished plates included)

CHAPTER ASSIGNMENT:

The assignments should be given to the student a week in advance for study.

TEXT:

Welding Skills & Practices

Hobart - 269 - GTAW

Hobart - 269 - SEMI

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TOPIC OUTLINE

Week	PAT Cassette Topic	Class Topic	Electrode Size/Type	Performance Objectives	Text Assignment
1		Orientation Safety course Outline			
2,3		Single Vee Groove Weld-Butt Joints W/Backing	E-7018	1	
		Machine Oxygen Cut Test Plates Or Guided Bend Test			
4,5 6,7	16	Set Up-Tack Weld Single Vee Groove Weld-Open Butt Joints Without Backing	E-6010	2	
		Weld Single Vee Groove Weld-Open Butt Joints Without Backing		3	
		Root Pass	E-6010		
		Cover Passes	E-7018		
					Hobart - 269-GTAW Page
8,9 10,11		Set Up And Shutdown GTAW (TIG) Equipment (AC)		4	61
		Set Up And Shutdown GTAW (TIG) Equipment (DC)		5	10
		Weld Aluminum With GTAW (TIG) Equipment, Flat Position, Stringer Beads		6	62
		Weld Aluminum With GTAW (TIG) Equipment, Flat Position, Butt Weld		7	66
		Weld Aluminum With GTAW (TIG) Equipment Flat Position, Outside Corner Weld		8	71

Week	PAT Cassette Topic	Class Topic	Electrode Size/Type	Performance Objectives	Text Assignment
		Weld Aluminum with GTAW (TIG) Equipment, Horizontal Position, Lap Joint, Fillet Weld		9	Welding Skills & Practices Chapter 17
	Movie 16 mm	#12 Gas Tungsten Arc Welding by: Miller			Hobart - 269- Semi Pages 3 thru 7
12,13,14		Set Up and Shut Down GMAW (MIG) Equipment		10	
		Weld Carbon Steel With GMAW Equipment in the 2G Position T-Joints		11	2
		Weld Carbon Steel with GMAW Equipment in the 1G Position Open Square Butt Joint		12	8
		Weld Carbon Steel with GMAW Equipment in the 3G Position T-Joints (up)		13	4
	Movie 16 mm	#10 Short Circuiting Metal by: Miller			
15		Weld Carbon Sttel Plates Using FCAW Equipment in the 2G Position		14	Hobart - 269 - Semi Page 42
		Weld Carbon Steel Using FCAW Equipment in the 3G Position T-joint Vertical Up		15	
16		FINAL EXAM			
		WRITTEN TEST ON ABOVE PROCEDURES			

DUTIES & TASKS

A supply of the Competency Based Duties & Tasks are available in each welding laboratory.

The instructor should issue the duties and tasks to the student as he progresses through the course so that the student knows exactly what he is to do and how his performance will be evaluated.

DUTY: Set Up, Tack And Weld Metal Processing Projects

TASK: Set Up, Tack, And Weld Single Vee Groove Weld - Butt Joints With Backing In The 4G Position (ASME)

1. Performance Objective

Given two 3/8" x 3" x 6" plates, backing strip and welding equipment, set up, align and tack weld plates to backing according to ASME specifications, section IX, pg. 4,6,13, QW-469.1.

Position test plates in the 4G position and weld as per instructors specifications.

Criterion-Referenced Measure

Set up two 3/8" x 3" x 6" plates with backing strip, tack and weld to specifications.

Performance Guide

1. Select safety and welding equipment
2. Clean plates and backing strip
3. Space plates to proper root opening with backing as per ASME specifications
4. Use E-7018 electrodes with diameters as per instructors specifications
5. Tack plates as per instructors specifications
6. Weld plates in the 4G position according to instructions

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DUTY: Set Up, Tack And Weld Metal Processing Projects

TASK: Set Up And Tack Weld Single Vee Groove Weld - Open Butt Joints Without Backing In The 3G Position (AWS)

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2. Performance Objective

Given two 3/8" x 3" x 6" plates and welding equipment, set up, align, and tack plates according to AWS specifications, D1.1-75, 5.20A, pg. 60.

Criterion-Referenced Measure

Set up two 3/8" x 3" x 6" plates and tack according to specifications

Performance Guide

1. Select safety and welding equipment
2. Clean plates
3. Space plates to proper root opening as per AWS specifications
4. Use E-6010 electrodes (1/8" diameter) for tack welding
5. Tack plates as per instructors specifications

WELDING IV

72202

DUTY: Set Up, Tack And Weld Metal Processing Projects

TASK: Set Up, Tack, And Weld Single Vee Groove Weld - Open Butt Joints Without Backing In The 3G Position (AWS)

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3. Performance Objective

Given two 3/8" x 3" x 6" plates and welding equipment, set up and align plates according to instructors specifications using the controlled penetration technique in the 3G position.

Criterion-Referenced Measure

Set up two 3/8" x 3" x 6" plates, tack, and weld according to specifications using the controlled penetration technique.

Performance Guide

1. Select safety and welding equipment
2. Clean plates
3. Space plates to proper root opening as per AWS specifications
4. Tack weld as per instructors specifications
5. Use E-6010 1/8" diameter electrodes for root pass, finish passes should be welded with E-7018 3/32" or 1/8" diameter electrodes.
6. Weld as per instructors specifications

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DUTY: Operating Tungsten Inert Gas Welding Equipment (TIG)

TASK: Set Up and Shutdown GTAW (TIG) Equipment (AC)

4. Performance Objective

Given a GTAW (TIG) unit, tools and materials, set up and shut down power supply for welding aluminum or magnesium.

Criterion-Referenced Measure

Set up and shut down a TIG unit for aluminum welding

Performance Guide

1. Select safety equipment
2. Set up power supply for aluminum welding
3. Mount flow meter to argon cylinder
4. Adjust shielding gas flow rate, cubic feet hour (CFH)
5. Select proper tungsten
6. Prepare tungsten and place in torch and adjust for proper electrode stickout
7. Bleed gas line and shut down equipment completely.

WELDING IV

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DUTY: Operating Tungsten Inert Gas Welding Equipment

TASK: Set Up and Shut Down GTAW (TIG) Equipment (DC)

5. Performance Objective

Given a GTAW (TIG) unit, tools and materials, set up and shut down power supply for welding stainless steel or mild steel.

Criterion-Referenced Measure

Set up and shut down for mild or stainless steel welding

Performance Guide

1. Select safety equipment
2. Set up power supply for mild or stainless steel welding
3. Mount flow meter to argon cylinder
4. Adjust shielding gas flow rate, cubic feet hour (CFH)
5. Select proper tungsten
6. Prepare tungsten and place in torch and adjust for proper electrode stickout
7. Bleed gas line and shut down equipment completely

WELDING IV

72202

DUTY: Operating Tungsten Inert Gas Welding Equipment (TIG)

TASK: Weld Aluminum with GTAW (TIG) Equipment, Flat Position, Stringer Beads

6. Performance Objective

Given a GTAW (TIG) unit, welding specifications, aluminum plate, filler rod and tungsten electrode, weld stringer beads on alumnimum plate in the flat position. Visual inspection will show:

a. smooth and continuous welds
b. ripple spacing 1/16" to 1/8"
c. little or no change in bead height or width
d. crater filled to bead height at the end of the weld
e. at least three (3) 5" long stringer beads on the 1/8" x 2" x 6" plate

Criterion-Referenced Measure

Weld stringer beads in the flat position on aluminum plate

Performance Guide

1. Select safety equipment
2. Set up equipment
3. Position all cables and hoses so as not to be burned or damaged
4. Turn on electrical equipment
5. Turn on and check water flow, as required
6. Turn on and adjust shielding gas
7. Adjust current
8. Weld stringer beads according to instructors specifications

WELDING IV

72202

DUTY: Operating Tungsten Inert Gas Welding Equipment (TIG)

TASK: Weld Aluminum With GTAW (TIG) Equipment, Flat Position, Butt Weld

7. Performance Objective

Given two aluminum plates 1/8" x 2" x 6", GTAW (TIG) unit, tungsten electrode, filler rod and welding specifications, set up, align and tack plates for a flat butt weld. Weld plates as per instructors specifications. Visual inspection will show:

a. smooth and continuous welds
b. complete penetration
c. no cracks undercutting or overlap
d. crater filled to bead height at the end of the weld

Criterion-Referenced Measure

Weld aluminum joints to welding specifications using GTAW (TIG) unit

Performance Guide

1. Select safety equipment
2. Set up equipment
3. Position all cables and hoses so as not to be burned or damaged
4. Turn on electrical equipment
5. Turn on and check water flow, as required
6. Turn on and adjust shielding gas
7. Adjust current
8. Set up and tack plates as per instructors specifications
9. Make a butt-joint weld as per instructors specifications

WELDING IV

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DUTY: Operating Tungsten Inert Gas Welding Equipment (TIG)

TASK: Weld Aluminum with GTAW (TIG) Equipment, Flat Position, Outside Corner Weld

8. Performance Objective

Given two aluminum plates 1/8" x 2" x 6" GTAW (TIG) unit, tungsten electrode and welding specifications, set up, align and tack plates for an outside corner weld (flat position) as per instructor's specifications. The weld is to be made without filler rod, visual inspection will show:

a. smooth and continuous welds
b. complete penetration
c. no cracks undercutting or overlap
d. filler rod may be used to fill crater to bead height at the end of the weld
e. hairline bead protruding from opposite side of joint to show 100% penetration

Criterion-Referenced Measure

Weld outside corner joints w/out filler rod using a GTAW (TIG) unit.

Performance Guide

1. Select safety and welding equipment
2. Set up equipment
3. Position all cables and hoses so as not to be burned or damaged
4. Turn on electrical equipment
5. Turn on and check water flow, as required
6. Turn on and adjust shielding gas
7. Adjust current
8. Set up and tack plates as per instructor's specifications
9. Make an outside corner weld without filler rod as per instructor's specifications

WELDING IV

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DUTY: Operating Tungsten Inert Gas Welding Equipment (TIG)

TASK: Weld Aluminum with GTAW (TIG) Equipment, Horizontal Position, Lap Joint, Fillet Weld

9. Performance Objective

Given two aluminum plates 1/8" x 2" x 6" GTAW (TIG) unit, tungsten electrode and welding specifications, set up, align, tack, and weld plates in the 2G position as per instructor's specifications. Visual inspection of welds will show:

a. smooth and continuous welds
b. ripple spacing 1/16" to 1/8" apart
c. no cracks, undercutting or overlap
d. bead should be convex, edges should be smooth and have even ripples
e. crater should be filled to bead height at end of weld

Criterion-Referenced Measure

Weld aluminum joints to welding specifications using a GTAW (TIG) unit

Performance Guide

1. Select safety equipment
2. Set up equipment
3. Position all cables and hoses so as not to be burned or damaged
4. Turn on electrical equipment
5. Turn on and check waterflow, as required
6. Turn on and adjust shielding gas
7. Adjust current
8. Set up and tack plates as per instructor's specifications
9. Place lap joint on table for horizontal welding and weld as per instructions

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DUTY: Operating Gas Metal Arc Welding Equipment (GMAW)

TASK: Set Up and Shut Down GMAW (MIG) Equipment

10. Performance Objective

Given a GMAW (MIG) unit, CO_2 cylinder, CO_2 regulator and materials, set up unit for welding. After setting up unit, shut down unit completely as per instructor's specifications.

Criterion-Referenced Measure

Properly set up a GMAW unit and shut down completely

Performance Guide

1. Select safety equipment
2. Set up power supply
3. Adjust shielding gas flow rate, cubic feet hour (CFH)
4. Set voltage and wire feed speed for flat position welding on 1/8" mild sheet steel. Voltage and wire feed speed must be set when welding. (On scrap material).
5. Close cylinder valve completely and bleed gas line, shut down equipment as per instructions
6. When the welding station is shut down, all controls should be returned to zero. At the start of each project the controls will have to be adjusted for correct operations

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DUTY: Operating GAs Metal Arc Welding Equipment (GMAW)

TASK: Weld Carbon Steel with GMAW Equipment in the 2 G Position, T-Joints, Fillet Welds

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11. Performance Objective

Given a GMAW unit, two steel plates 1/8" x 2" x 6", and instructors specifications, set up, align, and tack weld plates in the 2G position using a T-joint configuration. Make a 3/16" to 1/4" equal leg fillet weld on one side (opposite side of tacks), a 3/8" to 1/2" equal leg fillet. Weld the other side, visual inspection of welds will show:

a. even ripple spacing
b. no undercutting on vertical member
c. complete crater fill at end of weld
d. no overlap
e. leg size on fillet welds equal or close to being equal

Criterion-Referenced Measure

Make fillet welds in the 2G position using the GMAW equipment

Performance Guide

1. Select safety equipment
2. Select hand tools
3. Set up power supply
4. Check to see if nozzle on gun is clean (spray with anti-spatter)
5. Adjust shielding gas flow rate
6. Set voltage and wire feed speed (amperage) on scrap material
7. Tack plate to specifications
8. Place T-joint flat on table
9. Weld as per instructions

WELDING IV

72202

DUTY: Operating Gas Metal Arc Welding Equipment (GMAW)

TASK: Weld Carbon Steel with GMAW Equipment in the 1G Position Open Square Butt Joint

12. Performance Objective

Given two 1/8" x 2" x 6" steel plates, a GMAW unit and accessories, set up, align and tack plates as per instructor specifications, Make an open butt weld in the flat position, visual inspection will show:

a. even ripples
b. 100% penetration (slight crown at bottom of bend (opposite face of weld)
c. no excessive penetration
d. no burn thru
e. no whiskers
f. crater filled at welds end

Criterion-Referenced Measure

Make an open butt weld in the 1G position using GMAW equipment

Performance Guide

1. Select safety equipment
2. Select hand tools
3. Set up power supply
4. Check to see if nozzle on gun is clean (spray with anti-spatter)
5. Adjust shield ing gas flow rate
6. Set voltage and wire feed speed (amperage) on scrap material
7. Tack plate to specification
8. Place tacked plates in flat position
9. Weld as per instructions

WELDING IV

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DUTY: Operating Gas Metal Arc Welding Equipment (GMAW)

TASK: Weld Carbon Steel with GMAW Equipment in the 3G Position T-Joints (Up)

13. Performance Objective

Given 1/4" x 3" x 6" plates (two) a GMAW unit and accessories, set up align, and tack plates using a T-joint configuration. Set up plates in the 3G position and deposit the first bead on each side of the T-joint, (face should be 5/16" wide) then weave a second bead over first bead on one side only (face should be 1/2" wide). Visual inspection will show:

a. little or no undercut at toes of welds
b. ripples even spaced, little or no sag of the molten puddle
c. proper overlap of weave bead when deposited over first bead
d. slightly convex bead face
e. proper crater fill

Criterion-Referenced Measure

Perform a vertical up weld using the GMAW equipment

Performance Guide

1. Select proper safety equipment
2. Select hand tools
3. Clean nozzle (spray with anti-spatter)
4. Adjust shielding gas flow
5. Set voltage and wire feed speed (amperage) on scrap plates
6. Tack plates to specifications
7. Place tacked T-joint in the 3G position
8. Weld as per instructions

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DUTY: Operating Flux-Cored Arc Welding Equipment with Gas/without Gas

TASK: Weld Carbon Steel Plates Using FCAW Equipment in the 2G Position

14. Performance Guide

Given two plates, one 3/8" x 2" x 6" and one 3/8" x 3" x 6", a FCAW unit, materials and specifications, set up, align, and tack plates using a T-joint configuration. Set up plates in the 2 G position and deposit the first bead on each side of the T-joint, (welding opposite side of tacks first), then deposit the second and third bead on one side only. Visual inspection will show:

a. convex face
b. one side of T-joint 1/4" equal leg fillet, the other side 3/8" to 1/2" equal leg fillet weld
c. little or no undercut
d. no overlap
e. crater filled at beads end

Criterion-Referenced Measure

Make a horizontal multi-pass fillet weld using the FCAW equipment

Performance Guide

1. Select safety equipment
2. Select hand tools
3. Clean nozzle on gun if needed, spray with anti-spatter
4. Adjust shielding gas flow (if using gas as shield)
5. Set voltage and wire feed speed (amperage) on scrap plate
6. Tack plates
7. Place T-joint flat on table
8. Set nozzle to work (wire stickout)
9. Weld as per instructors specifications

WELDING IV

72202

DUTY: Operating Flux-Cored Arc Welding Equipment with Gas/ without Gas

TASK: Weld Carbon Steel Using FCAW Equipment in the 3G Position T-Joint Vertical Up

15. Performance Objective

Given two plates, one 3/8" x 2" x 6", one 3/8" x 3" x 6", a FCAW unit, tools, materials, and welding specifications, set up, align and tack plates using a T-joint configuration. Set up plates in the 3G position (vertical) and deposit the first bead on each side of the T-joint (weld opposite side of tacks first) then deposit the second and third layers (using weave beads each layer) on one side only.

Criterion-Referenced Measure

Make a vertical up multi-pass weld using the FCAW equipment

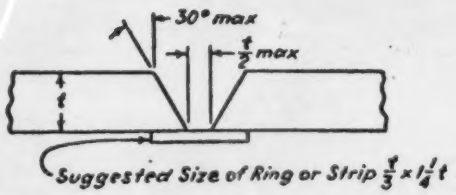
Performance Guide

1. Select safety equipment
2. Select hand tools
3. Clean nozzle on gun if needed, spray with anti-spatter
4. Adjust shielding gas flow (if using gas as shield)
5. Set voltage and wire feed speed (amperage) on scrap plate
6. Tack plates
7. Place T-joint in the vertical position (3G)
8. Set nozzle to work distance (wire stickout)
9. Weld as per instructors specifications

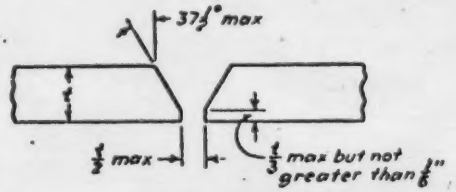
ASME WELDER QUALIFICATIONS

QW-469 Typical Test Joints

Joints used in all four welding positions when welding with backing strip, or without backing strip.



QW-469.1 BUTT JOINT



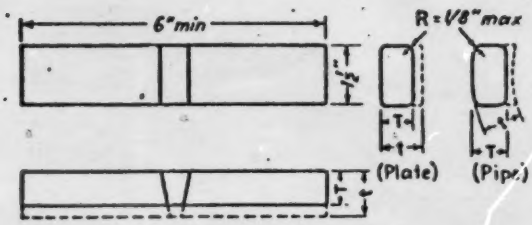
QW-469.2 ALTERNATIVE BUTT JOINT

QW-463 Order of Removal

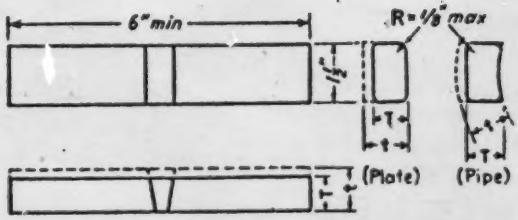
Discard		This Piece
Reduced Section		Tensile Specimen
Root Bend		Specimen
Face Bend		Specimen
Root Bend		Specimen
Face Bend		Specimen
Reduced Section		Tensile Specimen
Discard		This Piece

QW-463.1(a) PLATES—1/16 TO 3/4 IN. PROCEDURE QUALIFICATION

QW-462.3(a) Face and Root Bends - Transverse



Face Bend Specimens - Plate and Pipe



Root Bend Specimens - Plate and Pipe

t, In.	T, In.	
	Metals in QW-422.35 and QW-453	All Other Metals
1/16-1/8	t	t
1/8-3/8	1/8	t
>3/8	1/8	3/8

Note 1: Weld reinforcement and backing strip or backing ring, if any, shall be removed flush with the surface of the specimen. If a recessed ring is used, this surface of the specimen may be machined to a depth not exceeding the depth of the recess to remove the ring, except that in such cases the thickness of the finished specimen shall be that specified above. Do not flame-cut nonferrous material.

Note 2: If the pipe being tested is 3 inch outside diameter or less, the width of the bend specimen may be 3/4 inch, measured around the outside surface. Alternatively, if the pipe being tested is less than 2 inch pipe size (2.375 in. outside diameter), the width of the bend specimens may be that obtained by cutting the pipe into quarter sections, less an allowance for saw cuts or machine cutting.

QW-162 Guided-Bend Test Procedure

QW-162.1 Jigs. Guided-bend specimens shall be bent in test jigs that are in substantial accordance with QW-466. When using the jigs illustrated in QW-466.1 or QW-466.2, the side of the specimen turned toward the gap of the jig shall be the face for face-bend specimens, the root for root-bend specimens, and the side with the greater defects, if any, for side-bend specimens. The specimen shall be forced into the die by applying load on the plunger until the curvature of the specimen is such that a 1/8 in. diameter wire cannot be inserted between the specimen and the die of QW-466.1 or the specimen is bottom ejected, if the roller type of jig, QW-466.2 is used.

When using the wrap around jig, QW-466.3, the side of the specimen turned toward the roller shall be the face for the face-bend specimens, the root for the root-bend specimens, and the side with the greater defects, if any, for side-bend specimens.

When specimens wider than 1-1/2 in. are to be bent as permitted in QW-462.2(a) the test jig mandrel must be at least 1/4 in. wider than the specimen width.

QW-163 Acceptance Criteria - Bend Tests

The weld and heat affected zone of a transverse-weld bend specimen shall be completely within the bent portion of the specimen after testing.

The guided-bend specimens shall have no open defects exceeding 1/8 in., (1/16 in. for corrosion resistance weld overlay cladding), measured in any direction on the convex surface of the specimen after bending, except that cracks occurring on the corners of the specimen during testing shall not be considered unless there is definite evidence that they result from slag inclusions or other internal defects.

QW-303 Limits of Qualified Positions

QW-303.1 Groove Welds - General. Qualification in the 2G, or 3G, or 4G position shall also qualify for the 1G position. Qualification in both the 5G position shall qualify for the 1G, 3G, and 4G positions. Qualification in the 2G and 5G positions, or in the 6G position, shall qualify for all positions.

AWS WELDER QUALIFICATIONS

D1.1-75 Typical Test Joints

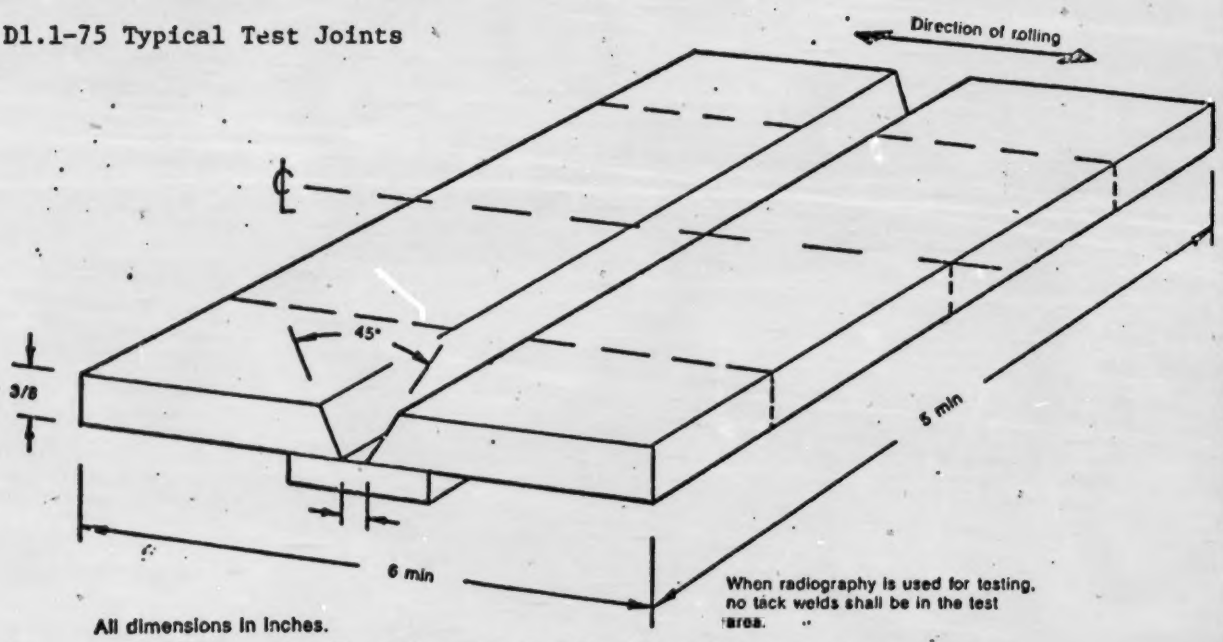

Direction of rolling
45°
3/8
5 min
6 min
When radiography is used for testing, no tack welds shall be in the test area.
All dimensions in inches.

Fig. 5.19a—Test plate for limited thickness—all positions—welder qualification.

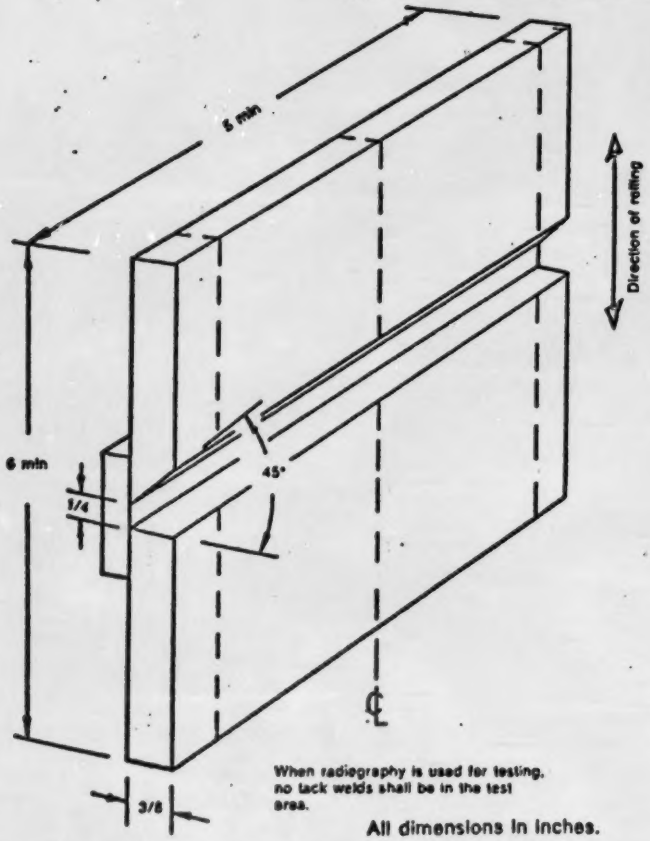


Fig. 5.19b—Optional test plate for limited thickness—horizontal position—welder qualification.

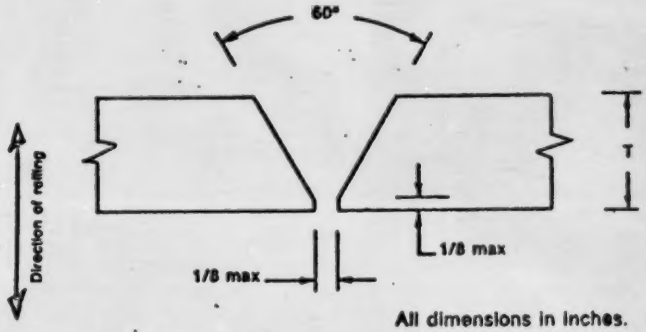


Fig. 5.20a—Plate and pipe butt joint—welder qualification—without backing.

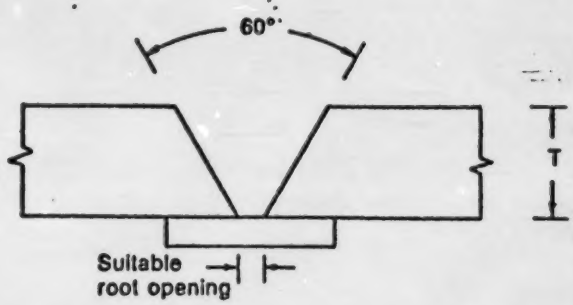
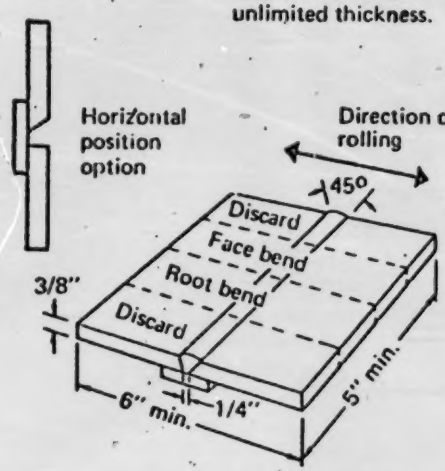


Fig. 5.20b—Pipe test butt joint—welder qualification—with backing.

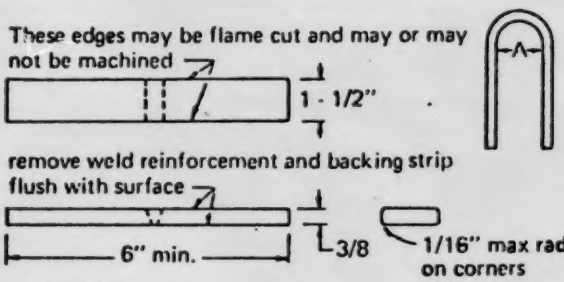
D1.1-75 Order of Removal

AWS Weldor Qualification Tests.

Limited thickness will qualify for groove welds in material not over 3/4" thickness and fillet welds on material of unlimited thickness.



Backing bar is at least 3/8" x 1". If radiography is used then use at least a 3/8" x 3" backing bar.


These edges may be flame cut and may or may not be machined
1 - 1/2"
remove weld reinforcement and backing strip flush with surface
6" min.
3/8
1/16" max radius on corners

Bend specimen passes if any crack or open defect does not exceed 1/8" after bending through an angle of 180°. Cracks at corners are not considered.
Radiographic inspection of test plate may be used instead of guided bend test. (A208)

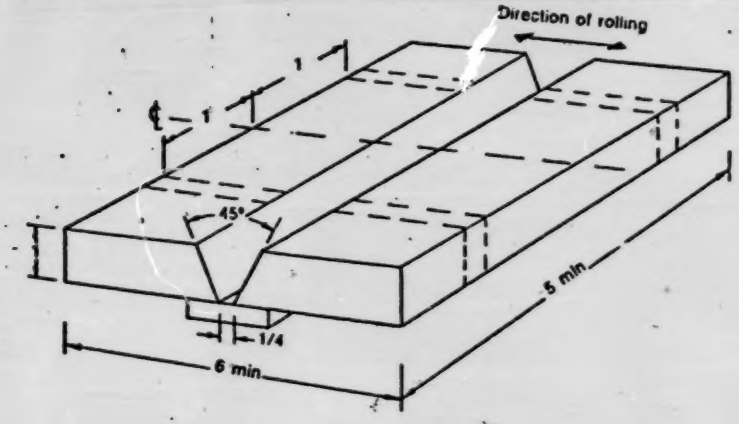


Fig. 5.18a—Test plate for unlimited thickness—welder qualification.

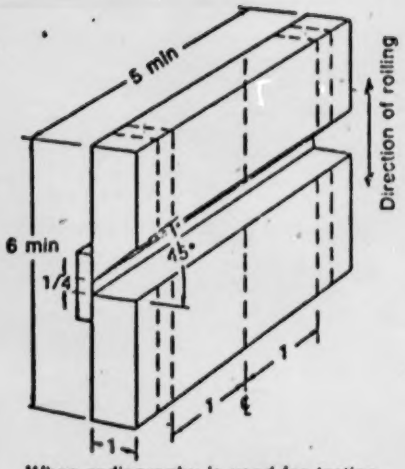


Fig. 5.18b—Optional test plate for unlimited thickness—horizontal position—welder qualification.

5.18 GROOVE WELD PLATE QUALIFICATION TEST FOR PLATE OF UNLIMITED THICKNESS

The joint detail shall be as follows: 1 in. (25.4 mm) plate, single-V-groove, 45 deg included angle, ¼ in. (6.4 mm) root opening with backing (see Fig. 5.18a). For horizontal position qualification, the joint detail may, at the contractor's option, be as follows: single-bevel-groove, 45 deg groove angle, ¼ in. root opening with backing (see Fig. 5.18b). Backing must be at least 3/8 in. (9.5 mm) by 3 in. (76.2 mm) if radiographic testing is used without removal of backing. It must be at least 3/8 in. by 2 in. (50.8 mm) for mechanical testing or for radiographic testing after the backing is removed. Minimum length of welding groove shall be 5 in. (127 mm).

5.19 GROOVE WELD PLATE QUALIFICATION TEST FOR PLATE OF LIMITED THICKNESS

The joint detail shall be as follows: 3/8 in. (9.5 mm) plate, single-V-groove, 45 deg included angle, ¼ in. (6.4 mm) root opening with backing (see Fig. 5.19a). For horizontal position qualification the joint detail may, at the contractor's option, be as follows: single-bevel-groove, 45-deg groove angle, ¼ in. root opening with backing (see Fig. 5.19b). Backing must be at least 3/8 in. by 3 in. (76.2 mm) if radiographic testing is used without removal of backing. It must be at least 3/8 in. by 2 in. (50.8 mm) for mechanical testing or for radiographic testing after the backing is removed. Minimum length of welding groove shall be 5 in. (127 mm).

5.20 GROOVE WELD QUALIFICATION TEST FOR BUTT JOINTS ON PIPE OR SQUARE OR RECTANGULAR TUBING

The joint detail shall be in accordance with a qualified welding procedure specification for a single-welded pipe butt weld or shall be as follows: pipe diameter-wall thickness as required, single-V-groove, 60 deg included angle, 1/8 in. (3.2 mm) max root face and root opening without backing strip (see Fig. 5.20a), or single-V-groove, 60 deg included angle and suitable root opening with backing (see Fig. 5.20b).

5.23 Position of Test Welds (See Table 5.23)

5.23.1 Groove Plate Test Welds

5.23.1.1. Qualification in the 1G (flat) position qualifies for flat position groove welding of plate, pipe and tubing, flat and horizontal position fillet welding of plate, and flat position fillet welding of pipe and tubing.

5.23.1.2. Qualification in the 2G (horizontal) position qualifies for flat and horizontal position groove and flat and horizontal position fillet welding of plate, pipe and tubing.

5.23.1.3. Qualification in the 3G (vertical) position qualifies for flat, horizontal, and vertical position groove and flat, horizontal, and vertical position fillet welding of plate.

5.23.1.4. Qualification in the 4G (overhead) position qualifies for flat and overhead position groove and flat, horizontal, and overhead position fillet welding of plate.

Table 5.23—Welder qualification—type and position limitations

Qualification test		Type of weld and position of welding qualified*			
		Plate		Pipe	
Weld	Plate or pipe positions**	Groove	Fillet	Groove	Fillet
Plate — groove	1G	F	F, H	F	F
	2G	F, H	F, H	F, H	F, H
	3G	F, H, V	F, H, V		
	4G	F, OH	F, H, OH		
	3G & 4G	All	All		
Plate — fillet	1F		F		F
	2F		F, H		F, H
	3F		F, H, V		
	4F		F, H, OH		
	3F & 4F		All		
Pipe — groove	1G	F	F, H	F	F
	2G	F, H	F, H	F, H	F, H
	5G	F, V, OH	F, V, OH	F, V, OH	F, V, OH
	6G	Note 1	Note 1	Note 1	Note 1
	2G&5G	Note 1	Note 1	Note 1	Note 1
	6GR	All	All	All	All

D1.1-75 Guided-Bend Test Procedure

5.27 Method of Testing Specimens

5.27.1 Root-, Face-, or Side-Bend Specimens. Each specimen shall be bent in a jig having the contour shown in Fig. 5.27.1 and otherwise substantially in accordance with that figure. Any convenient means may be used to move the male member with relation to the female member.

The specimen shall be placed on the female member of the jig with the weld at midspan. Face-bend specimens shall be placed with the face of the weld directed toward the gap. Root-bend and fillet-weld soundness specimens shall be placed with the root of the weld directed toward the gap. Side-bend specimens shall be placed with that side showing the greater discontinuity, if any, directed toward the gap.

The plunger shall force the specimen into the die until the specimen becomes U-shaped. The weld and heat-affected zones shall be centered and proportioned completely within the bent portion of the specimen after testing.

When using a wrap around jig, the specimen shall be firmly clamped on one end so that the specimen does not slide during the bending operation. The weld and heat-affected zones shall be completely within the bent portion of the specimen after testing. Test specimens shall be removed from the jig when the outer roll has been moved 180 deg. from the starting point.

D1.1-75 Acceptance Criteria - Bend Tests

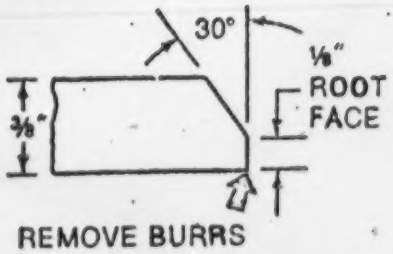
5.12.1.2 Root-, Face-, and Side-Bend Tests. The convex surface of the specimen shall be examined for the appearance of cracks or other open discontinuities. Any specimen in which a crack or other open discontinuity exceeding 1/8 in. (3.2 mm) measured in any direction is present after the bending, shall be considered as having failed. Cracks occurring on the corners of the specimen during testing shall not be considered.

CONTROLLED PENETRATION

SINGLE VEE

GROOVE WELD-BUTT

VERTICAL POSITION



1. PREPARE MATERIAL

   Bevel one 8 inch edge of each plate.

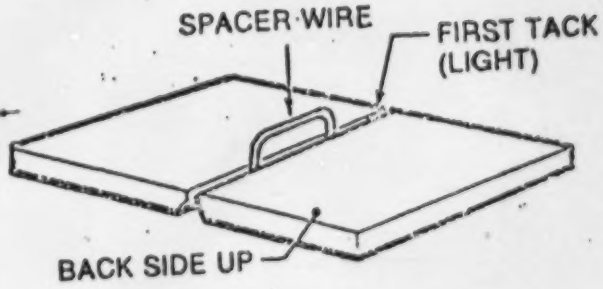
   - Grind 1/8" root face.

   - Remove burrs on back side of plate.

2. SET MACHINE

   Polarity: Electrode positive (reverse polarity)
   Current setting: 70-110 amps (1/8" E6010)
   110-140 amps (1/8" E7018) Approximately
   70-110 amps (3/32" E7018)

3. TACK WELD MATERIAL



   Position plates on table as shown.

   - Separate plates with 1/8" U-shaped wire spacer.

   - Hold plates tightly together.

   Deposit light tack weld at one end.

   - Remove wire next to this tack weld.

   - Hold plates together against other end of spacer wire.

   Deposit light tack weld at opposite end.

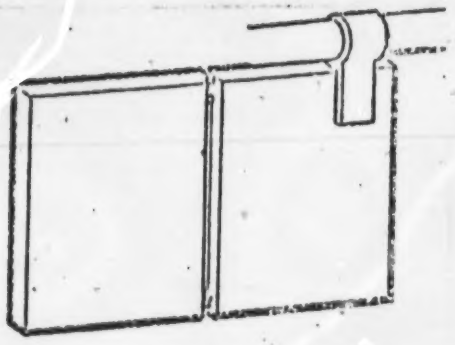
   - Remove spacer wire immediately after depositing tack weld.

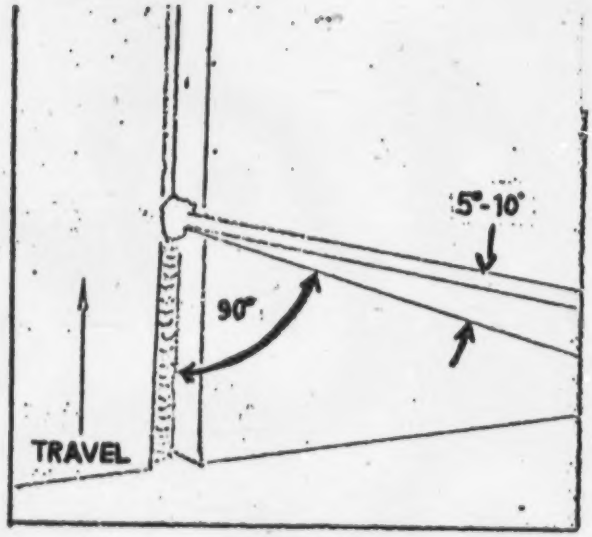
   - Remove slag from both tack welds and reinforce tack welds to 3/8" on back side.

   - Joint spacing must be a tight 1/8" and the root faces parallel.

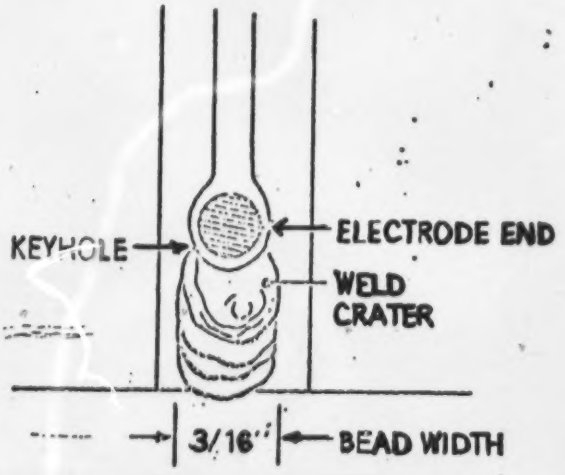
4. POSITION WORKPIECE

Clamp workpiece in vertical position as shown.





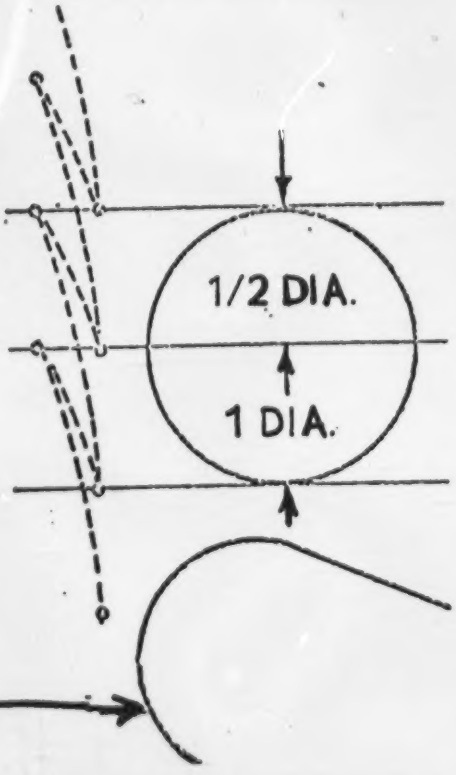
SIDE VIEW



Angle electrode 5^0 to 10^0 up from horizontal. No side angle.
Start weld puddle, then melt out keyhole as large as electrode diameter (including flux coating).

Fill crate to 3/16" bead width.

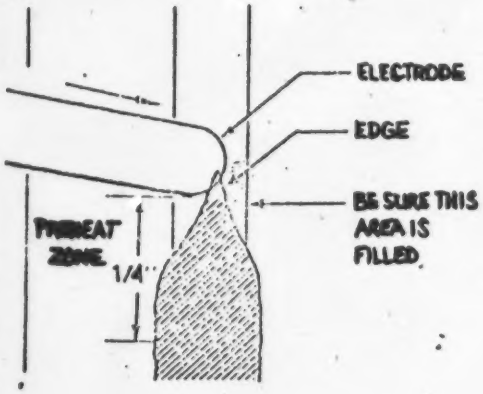
Whip electrode up not over 1/8" with close arc length (chills weld puddle). Move electrode down one-half electrode diameter to weld puddle. Fill crater again. Whip electrode up again to melt out keyhole.



ELECTRODE MOVEMENT

If arc is broken before bead is finished, remove slag from crater, and restrike arc ½" ahead of crater. Move electrode to crater and fill to bead size before resuming travel.

Move electrode back and forth to preheat weld zone, then push electrode into keyhole to knock off narrow edge of weld. Push electrode down to fill bead on root side (eliminates notched-in places), then continue weld.



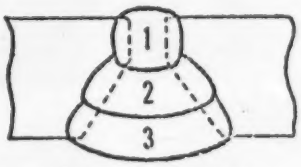
SECTION VIEW

Second bead using 3/32" E7018 electrode.

- Use tight Z-weave electrode movement.
- Always remove slag before depositing another bead.

Third bead using 1/8" E7018 electrode.

- Use same procedure as for second bead.
- Cool workpiece in still air. Do not dip workpiece in water.



BEAD SEQUENCE

STUDENT RECORDS

WELDING IV - 72202 - COMMUNITY COLLEGE OF ALLEGHENY COUNTY - CENTER-NORTH

STUDENT NAME _____ SOCIAL SECURITY NUMBER _____

This is to certify that the above-named student has demonstrated proficiency in the following tasks:

Competency Task	Completed	Instructor
1. Set up - tack and weld vee groove w/backing (ASME) 4G position E-7018		
2. Set up - tack weld vee groove without backing E-6010		
3. Weld vee groove without backing (AWS) 3G position E-6010 - E-7018		
4. Set up - shut down Tig equipment - aluminum		
5. Set up - shut down Tig equipment - steel		
6. GTAW aluminum stringer beads - flat position		
7. GTAW aluminum butt welds - flat position		
8. GTAW aluminum corner weld - flat position		
9. GTAW aluminum lap weld - horizontal position		
10. Set up - shut down GMAW equipment		
11. Weld T-joints horizontal position with GMAW equipment steel		
12. Weld butt joints flat position GMAW equipment - steel		
13. Weld T-joints vertical up GMAW equipment - steel		
14. Weld T-joints horizontal position FCAW equipment - steel		
15. Weld T-joints vertical up FCAW equipment - steel		

WELDING IV - 72202

STUDENT RECORD-CLASS ROSTER

DATE

1	Set up - tack and weld vee groove w/backing (ASME) 4G position - E-7018
2	Set up - tack weld vee groove without backing E-6010
3	Weld vee groove without backing (AWS) 3G position E-6010 E-7018
4	Set up - shut down tig equipment - aluminum
5	Set up - shut down tig equipment - steel
6	GTAW aluminum stringer beads flat position
7	GTAW aluminum butt welds - flat position
8	GTAW aluminum corner weld flat position
9	GTAW aluminum lap weld horizontal position
10	Set up - shut down GMAW equipment
11	Weld T-joints horizontal position with GMAW equipment - steel
12	Weld butt joints - flat position GMAW equipment - steel
13	Weld T-joints vertical up GMAW equipment - steel
14	Weld T-joints horizontal position FCAW equipment - steel
15	Weld T-joints verical up FCAW equipment - steel

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